Experimental characterization and numerical simulation of Inconel 718 under large plastic deformation

†S. Dodla*, A. Roy, and Vadim V. Silberschmidt

Wolfson School of Mechanical, Electrical and Manufacturing Engineering, Loughborough University, Loughborough, Leicestershire LE11 3TU, UK.

*Presenting author: S.Dodla@lboro.ac.uk
†Corresponding author: S.Dodla@lboro.ac.uk

Abstract

Nickel-based alloys have been widely used in the aerospace industry thanks to their excellent high-temperature mechanical properties [1]. In the current study, a polycrystalline Inconel 718 was used to investigate the underlying mechanisms responsible for such high mechanical properties. Characterization of microstructure including its texture was performed using microscopy (optical, SEM) and EBSD. The measured texture was approximated with a set of 500 discrete orientations for numerical simulations. Compression tests were also performed on polycrystalline samples to study their stress-strain behavior along two different directions. The material parameters were identified using an elasto-visco-plastic single-crystal constitutive model. The model is based on the concept of isomorphic elastic ranges [2, 3]. Numerical homogenization was implemented using the finite-element software package ABAQUS, and the predicted stress-strain behavior was compared with the experimental results. Finally, the identified material parameters were used to validate the developed model. The simulated mechanical behavior was compared with the experimental data.

Keywords: Crystal-plasticity material model, Inconel 718, SEM/EBSD, Crystallographic texture, Compression tests.

References

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